

EFFECT OF AGGREGATE ON COKING OF BINDER IN PETROLEUM COKE-PITCH MIXTURES

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During investigation of pitches, it was observed that when pitch and calcined petroleum coke were mixed together and heated at about 130°C, the paste showed striking differences; its appearance varied from wet and sticky to sandy and dry, as proportions of the two components were changed. The transition was sharp, and the binder:aggregate ratio at which it occurred varied for a number of pitches, in some cases even for pitches of similar softening points. It was also found that increasing the temperature intensified the interaction between pitch and aggregate and enhanced differences in appearance of the heated mixtures. These qualitative observations were followed by quantitative tests involving preheating steps at temperatures below 400°C followed by a coking treatment at 550°C. Several mixtures were prepared containing from 30 to 70% of -200 mesh calcined petroleum coke in increments of 5 to 10%. After thorough mixing, the mixtures were placed in porcelain crucibles fitted with a lid and the whole was imbedded in calcined petroleum coke inside a nickel crucible. After heating for 30 minutes at 200°C and 30 minutes at 300°C in a muffle furnace, the mixtures were coked at 550°C for two hours. The percentage of original pitch converted into coke was calculated from the total carbon residue corrected for the original weight of aggregate; weight loss of the aggregate itself was negligible.

FIGURE 1, illustrates the effect of preheating on the amount of pitch coke formed during the coking step. With no preheating, the yield of pitch coke remains fairly constant over the entire range of binder:aggregate ratios, and is substantially the same as the coking value of the pitch determined separately. With the mixtures preheated at 200 and 300°C, the results are quite different. For high contents, variations in pitch coke yield are not significant. However, when the pitch content decreases to a point - which we call the "saturation point" - where the mixture presumably is no longer saturated with pitch, the pitch coke yield increases suddenly up to a level at which it remains fairly constant even with further reduction in pitch content. The sharp increase in pitch coke yield coincides with the visible change in the appearance of mixtures mentioned previously.

The shape of the curve and location of the saturation point are influenced by the particle size of the aggregate as shown in FIGURE 2. The heating programme was also found to be critical, especially in the range from 200 to 400°C where the pitch is extremely mobile and shows high wetting power towards the aggregate.

The increase in amount of pitch coke formed might be attributed to the retention of increasing quantities of volatile pitch fractions as the aggregate proportion in the mix increases; however, this increase in pitch coke yield would be expected to be gradual and not as sudden as the actually observed change. On the other hand, increasing the aggregate particle size results in a flattening of the curve indicating that surface area is also a factor. This is further supported by our findings that the increased coke yield occurs only with surface-active materials such as Fuller's earth and molecular sieves, whereas it does not so with a material such as glass powder which exhibits no surface activity. Surface area alone cannot, however, offer a complete explanation. The fact that the sharp increase can be obtained only

after pitch: aggregate mixtures have been given a preheating treatment should also be taken into consideration. Preheating probably permits pitch to displace the air or other gases absorbed by the aggregate and to enter into better contact with the latter before being coked. When coking is carried out without preheating, any gases escaping from the aggregate surface presumably interfere with the interaction between the two components. Other factors are undoubtedly involved and consequently no full explanation can yet be offered for the increase in pitch coke yield when binder and petroleum coke are mixed and heated under controlled conditions.

The technique described above provides an additional test for comparison of binders from different sources or of different types; TABLE 1 lists some results obtained and shows that saturation point tends to vary with quinoline insoluble content, but cannot be related to softening point or coking value. The procedure can also be applied to comparison of aggregate cokes, and in certain cases to estimation of binder requirements.

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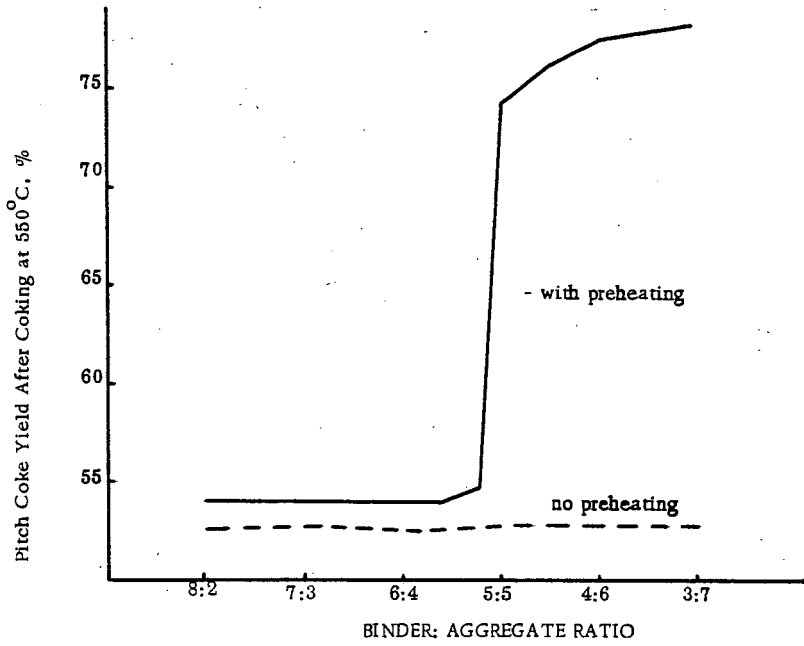


FIGURE 1

EFFECT OF PREHEATING ON PITCH COKE YIELD IN BINDER: AGGREGATE MIXTURE

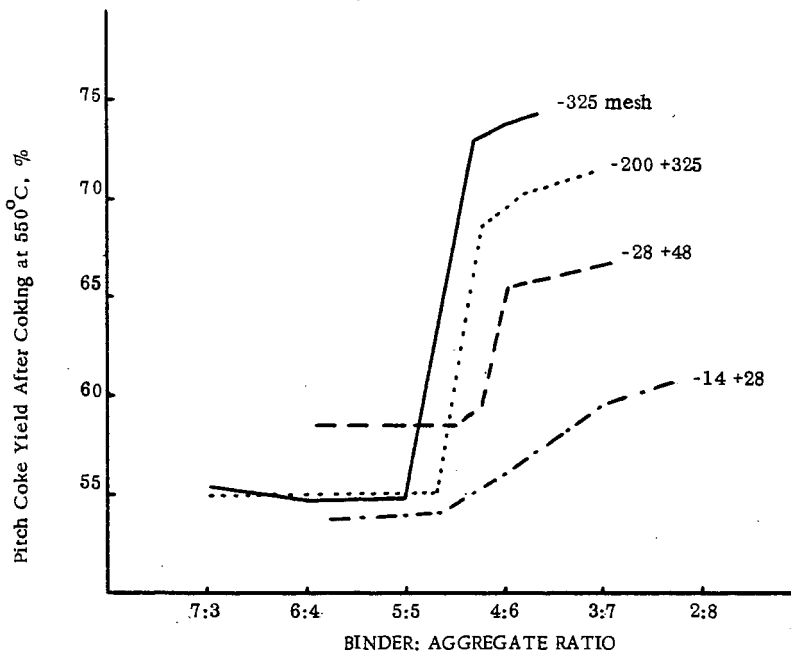


FIGURE 2

EFFECT OF PARTICLE SIZE OF AGGREGATE ON SATURATION POINT AND CURVE

TABLE 1
SATURATION POINTS OF PITCHES FROM VARIOUS SOURCES

Source ^(a)	Pitch ^(b) Type	% Pitch at Saturation Point	Softening Point Cube-in-Air, °C	Coking ^(c) Value %	Quinoline Insoluble %
A	CTP	75	100	62	29
		69	137	65	24
		57	111	62	14
		57	99	55	12
		53	102	53	4
B	CTP	57	50	45	13
		54	113	58	5
		53	112	55	5
		53	87	52	8
C	CTP	57	109	58	11
		53	107	56	8
D	CTP	59	109	57	11
E	CTP	57	92	57	13
F	PP	54	109	54	3
		49	114	56	2
G	PP	50	113	54	0
<p>(a) Letters represent different pitch producers.</p> <p>(b) CTP = coal-tar pitch PP = petroleum-base pitch</p> <p>(c) By regular coking value method. Ref. Fuel, XXXVII, 362-392 (1958)</p>					